Using Malware Analysis to Identify Overlooked Security Requirements (MORE)

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This material is based upon work funded and supported by the Department of Defense under Contract No. FA8721-05-C-0003 with Carnegie Mellon University for the operation of the Software Engineering Institute, a federally funded research and development center.

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DM-0004329
Topics

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Malware-Analysis-Driven Use Cases
Process for Creating Use Cases
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Current Status
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Problem Statement

Despite the reported attacks on critical systems, operational techniques like malware analysis are not used to inform early lifecycle activities, such as security requirements engineering.

• Operational techniques like malware analysis are typically used for patch generation; they don’t usually get fed back into the development process.

• Security requirements developers tend to either start with a blank slate or with large databases of candidate requirements and use cases.

• Creating and prioritizing security requirements may be done without the insights gained from analysis of prior attacks, especially those that are specific to a particular domain.
Creating a Vulnerability

Code flaws result from a lack of secure coding.
Design flaws result from overlooked requirements.

An unknown amount of time is needed to discover a vulnerability:
- discovered in software
- discovered as part of a malware exploit

If discovered
- and made public → patch it!
- and kept private → exploit it!
Malware-Analysis-Driven Use Cases

Malware already analyzed by domain expert
  • We start the process with the analysis results.

It’s exploiting a vulnerability!
  • Get the exploit details.

Design or code flaw?

If design, what requirements were overlooked that led to the flaw?

Create a use case from those requirements and add it to the database.
  • Goal: Requirements should prevent this flaw from occurring again.
Process for Creating Use Cases

1. The results are obtained from completed static and dynamic analysis of a malicious code sample.

2. Analyses reveal the malware is exploiting a vulnerability from either a code flaw or a design flaw.

3. In the case of a design flaw, the exploitation scenario corresponds to a misuse case that should be described.

4. The misuse case is analyzed to determine the overlooked security requirement and its corresponding use case.

5. The security requirements statement and corresponding use case are added to a requirements database.

6. The requirements database is used in future software development projects. (Traceability is retained across the steps and the use of requirements from the database is tracked.)
Case Studies
Application

K-9 Mail Application for Android

- Open source
- Provides searching and other common smartphone email client functionality
- User expectation of privacy and security
Vulnerability

**DroidCleaner**

- Trojan malware
- Claims to perform an Android tune-up.
- Sends premium-rate SMS messages.
- Uploads data from the Android External Storage area to hacker’s servers.
Exploitation Scenario

Trojan
- Social engineering to trick user into installing DroidCleaner:
  - Install software.
  - Grant access to external storage, internet access.

K-9 Mail configured to store email in External Storage.
DroidCleaner uploads External Storage to hacker server.
The hacker examines contents; email contents are disclosed.
Misuse Case

Gain Access to Email Contents

User

Android

K-9 Mail

Save Email Contents

Grant Access to File

Download email contents

Gain access to email contents

Hacker

Access Email

Compromise phone security

<<include>>

<<extend>>
## New Requirement

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<tr>
<td><strong>Misuse Case</strong></td>
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<td><strong>Rationale</strong></td>
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Tool Development
Tool Development: Initial Goal

To provide a proof of concept by implementing and automating the solution

To develop a web application that reads malware analysis reports and creates a database of misuse cases, use cases, and overlooked security requirements (MUOs)
Tool Development: Outcome

A tool to help report writers write more comprehensive reports and include the misuse cases, use cases, and overlooked security requirements from the start
Tool Development: MORE Tool

Two web-based applications
- Report Writer
- Security Requirement Finder (SERF)

User roles
- Public user
- Report writer
- Reviewer
- Administrator
- Super user
Current Status

Webpage cert.org/cybersecurity-engineering/research/security-requirements-elicitation.cfm

Release of prototype tool source code on GitHub

Several industry case studies by U.K. students

Paper and tool demo presented at Requirements Engineering Conference ESPRE Workshops and CMU faculty seminars
Discussion and Possible Future Work

Research activities

• Identify ways to use this method in threat modeling, in conjunction with the SEI threat modeling project
• Assess usefulness in other lifecycle activities (e.g., architecture and design).

Practical application of the method

• Apply this method to larger systems to increase the knowledge base.
• Work with organizations developing new systems or enhancing existing systems.

Tool/automation activities

• Revisit automated processing of malware reports.
• Revisit automated processing of CWEs in conjunction with Mitre reorganization of CWEs.